PG/IVS/EL - 2201/10

M.Sc. 4th Semester Examination, 2010

ELECTRONICS

(Microwave Devices and Circuits)

PAPER —EL-2201

(Theory)

Full Marks : 40

Time : 2 hours

Answer **Q.No.1** and any **three** from the rest

The figures in the right-hand margin indicate marks

Candidates are required to give their answers in their own words as far as practicable

Illustrate the answers wherever necessary

1. Answer any *five* questions : 2x5

(*a*) Explain the action of magnetic field used in the cavity magnetron.

(*b*) Write down the difference between the transferred electron devices and avalanche transist time devices.

(*c*) How can a 4 port directional coupler be utilized to measure the VSWR of a given load ?

(*d*) Prove that three ports of a loss-less passive Tee-junction, when reciprocal in nature, can not be matched simultaneously.

(*e*) What are the dominant modes of a circular cavity resonator ? State the advantages of TE_{01} mode over TE_{11} mode over TE_{11} mode of a circular cavity resonator.

(*f*) Why ferrite devices are called non-reciprocal devices ?

2. (*a*) A helix travelling wave tube is operated with a beam current of 300 mA, beam voltage of 5 kV, and characteristic impedance of 20 Ω. What length of the helix will be selected to give an output power gain of 50 dB at 10 GHz ? 5

(*b*) Draw the equivalent circuit of IMPATT diode. An IMPATT diode with nominal frequency of 10 GHz, has an R_d of - 3 Ω, RF peak current of 0·65 A and with breakdown bias of 80 V, 80 mA. Find the power gain in dB. 2 + 3

3. (*a*) What is a slow-wave structure? What is the major difference between the travelling wave tube and the klystron? 3

(*b*) Draw a schematic diagram of a helix TWT and explain its principle of operation. 7

4. (*a*) How a slot line differs from a microstrip line? 2

(*b*) Discuss the role of dielectric in the design of microstrip. Derive Q of a microstrip line. 2 + 2

(*c*) In a microstrip line, duroid ($\varepsilon_r = 2{\cdot}56$) is used as a substrate material and if the line has an attenuation of 20 dB and $Q = 10$, calculate the operating frequency of the line. 4

5. (*a*) Draw the schematic diagram of a GaAs MESFET and its small signal equivalent circuit. State the intrinsic and extrinsic elements of a MESFET.

(*b*) A GaAs : MESFET has the following parameters :

$R_G = 6\,\Omega$, $R_i = 2\,\Omega$, $g_m = 60\,\text{m mho}$,

$R_d = 400\,\Omega$, $R_s = 2\,\Omega$, $C_{gs} = 0{\cdot}5\,\text{pF}$

Determine :

(*i*) the cut-off frequency and

(*ii*) the maximum operating frequency.

(2 + 2) + 2 + (2 + 2)

6. (*a*) Discuss the physical structure and the principle of operation of a Quantum Well Injection Transit Time (QWITT) diode. 2 + 3

(*b*) What are the advantages of Microwave Integrated Circuits (MICs) over discrete circuits ? State the basic properties required for an ideal (*i*) substrate material and (*ii*) conductor material used in MICs. 2 + 3
